Measurement of the ^{10}C Superallowed Branch with GAMMASPHERE

B.K. Fujikawa[1], W.T. Winter[1,2], J.T. Burke[1,2], R.M. Clark[1], P. Fallon[1], S.J. Freedman[1,2], J.P. Greene[3], I-Y. Lee[1], A.O. Macchiavelli[1], N.D. Scielzo[1,2], J. Stalnaker[2], P.A. Vetter[1]

[1] *Nuclear Science Division, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA*
[2] *Physics Department, University of California, Berkeley, CA 94720, USA*
[3] *Physics Division, Argonne National Laboratory, Argonne, IL 60439, USA*

The u-d element (V_{ud}) of the Cabibbo-Kobayashi-Maskawa (CKM) quark-mixing matrix is a fundamental parameter of the Standard Model of Electroweak Interactions. Its most precise determination comes from nuclear physics experiments, in particular, from measurements of superallowed Fermi beta decays. These measurements, requiring both precision nuclear physics experiments and state of the art theoretical nuclear physics calculations, have been made for a variety of nuclei ranging from ^{10}C to ^{54}Co . The V_{ud} parameter obtained from these measurements implies a non-unitary CKM matix, which if correct would require exotic extensions to the Standard Model. Unfortunately the theoretical calculations of the isospin breaking corrections, neccesary for extracting V_{ud}, are controversial. For example, Wilkinson [1] has suggested that these calculations are incomplete and that isospinbreaking corrections must be extracted empirically. In order to resolve this controversy, much effort has recently been invested in making improved measurements of the superallowed decay of ^{10}C, where the isospin breaking corrections are expected to be small and any residual charge dependent corrections will be apparent. This is a very challenging measurement since the beta decay of ^{10}C has a small superallowed branching ratio which must be precisely determined in a high background environment. We are currently engaged in a series of experiments to measure the superallowed branching ratio of the ^{10}C beta decay using the GAMMASPHERE facility at the LBNL 88-inch Cyclotron. The first data run resulted in a branching ratio of $1.4665(38)x10^{-2}$ [2]. A second high statistics run was made in July 1997, but was unable to yield a precise result to the presence of an unwanted software filter left over from an earlier experiment. A third run in September 2001 was carried out with precautions, such as fast online diagnostic data analysis, made to ensure the integrity of the data. This data is currently

To measure the branching ratio using GAMMASPHERE, we produce ^{10}C in the center of GAMMASPHERE using the $^{10}B(p,n)^{10}C$ reaction. The beta decay of ^{10}C proceeds almost entirely to two excited states in ^{10}B. These ^{10}B states then decay by a gamma emission to the ground state, making it possible to determine the superallowed branching ratio simply by counting gamma ray yields in GAMMASPHERE. To determine the relative efficiency of GAMMASPHERE for the gamma rays invovled, we populate a high lying ^{10}B state via the $^{10}B(p,p')^{10}B^*$ reaction. This state sometimes decays by emitting the two gamma rays used to determine the branching ratio. This channel is accompanied by a third characteristic gamma ray, and by triggering on it we may determine the relative efficency of the other two.

[1] D.H. Wilkinson, Zeit Phys A348, 129(1994)
[2] B.K. Fujikawa, et al., Phys Lett B449, 6 (1999)

being analyzed and should improve the precision of our measurement to better than 10^{-3}.